

Application no.: 09/274,935
Amendment dated June 25, 2004
Reply to Office Action of February 27, 2004

REMARKS/ARGUMENTS

Reconsideration of the above-identified patent application is respectfully requested in view of the following remarks. Claims 1 - 20 remain in the case.

The present invention provides an etchant which, when combined with disclosed microetching techniques, removes a small layer of copper from copper features forming part of a printed circuit board. The components of the novel etchant, many of which have been used before, are used in a new combination. The resulting etchant works in combination with the disclosed and claimed etching process so that large quantities of copper are not removed from copper features on a printed circuit board or similar structure. The resulting etchant uniquely removes a small layer of copper, even when the copper features are connected to other metallic features, including noble metals. The copper is selectively removed in the present invention by applying an etchant comprising an inorganic acid, and persulfate and phosphate salts.

Claims 1, 2, 5, 6, 8, 9, and 13 were rejected under 35 U.S.C. §102(b) as being anticipated by Japanese Published Unexamined Patent Application No. 05-148658 for ELECTROLESS TIN-PLATING METHOD, filed November 22, 1991 by Akio Takatsu et al. TAKATSU has formed the basis for claims rejection throughout the prosecution of this application. The Examiner's rejection and Applicants' present response is based upon a computer-generated translation of the Japanese application.

TAKATSU discloses a method for electroless tin plating, such that whisker growth of the resulting tin plating, after the plating operation is complete, is minimized over an extended time, 60 days or more. To minimize such whisker growth, TAKATSU teaches the use of a pretreatment solution including an acid; a peroxide, "ammonium persulfate or hydrogen peroxide", and a compound of a straight chain or cyclic hydrocarbon solubilized by an anion, a "sulfate group or phosphate group or the salt of the (organic) compound"

(TAKATSU, Abstract) before electroless tinning. This is further described in the claims of TAKATSU, reciting "an acid, a peroxide, and an organic high molecular compound," post-plating annealing, alternative acids ("sulfuric acid, a hydrochloric acid, a nitric acid, and the phosphoric acids"), "ammonium persulfate" and "hydrogen peroxide", and the hydrocarbon compound.

TAKATSU further discloses a set of example formulations with results, where example 1 (page 4, line 27), example 2 (page 4, line 31), and example 3 (page 4, line 33) each use sodium dodecyl sulfate as the organic compound, and find the growth of tin whiskers to not occur after 60 days. Examples 4, 5, and 6 show similar results with other organic compounds, while example 7 (page 5, line 39) shows many whiskers after 2 days, using no organic compound. In the samples where whiskers do not occur, the organic compounds are solubilized with a sulfate or sulfonic acid anion.

The technique taught by TAKATSU contrast with the use of inorganic phosphate salts as disclosed by the present invention (page 13, line 17 through page 14, line 2).

TAKATSU uses the organic compound to smooth the copper surface by adsorption to the copper before electroless tin plating (page 3, line 22), in contrast to the microetching and micropitting caused by the present invention, where "the current formulation improves adhesion of copper surfaces ... by micro-roughening the surface. This micro-pitting creates a textured surface that provides greater surface area" (page 10, lines 7 - 10).

There are some similarities between the Applicants' formulation and that of TAKATSU. The differences are significant, most importantly including the use of an inorganic phosphate salt by the Applicants in order to stabilize the microetching solution. "The phosphate salts play several important roles in the process including, acting to buffer and stabilize the inventive microetchant formulation" (page 14, lines 10-13). TAKATSU, in contrast, teaches that a smooth surface minimizes whisker growth after an electroless

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tin plating operation, and adds a hydrocarbon component that may be solubilized with a phosphate anion, creating an organic phosphate salt; the phosphate anion serves merely to solubilize the organic compound, in order to smooth the copper surface (page 3, line 22). The Applicants' formulation is adapted to microetch and roughen copper features. The TAKATSU formulation is adapted to smooth copper features prior to electroless tin plating.

Since it is believed that TAKATSU does not anticipate the invention, and the rejection of claims 1, 2, 5, 6, 8, 9, and 13 of the present invention has been overcome, Applicants respectfully traverse the rejection under 35 U.S.C. §102(b) as being anticipated by TAKATSU.

Claims 14 - 20 were rejected under 35 U.S.C. §103(a) as being unpatentable over TAKATSU in view of United States Patent No. 6,281,090 for METHOD FOR THE MANUFACTURE OF PRINTED CIRCUIT BOARDS WITH PLATED RESISTORS, issued August 28, 2001 to Peter Kukanskis et al. and United States Patent No. 4,774,491 for METAL FILM RESISTOR, issued September 27, 1988 to Ludovicus Vugts.

KUKANSKIS teaches a process whereby resistors may be manufactured integral with a printed circuit board by plating the resistors onto the insulative substrate.

VUGTS teaches a discrete (i.e., not formed on circuit substrate) metal film resistor utilizing resistive elements comprising Ni-Al.

As discussed hereinabove, the admixture of TAKATSU differs significantly from the Applicants' formulation. Adding the teachings of KUKANSKIS and/or VUGTS still fails to suggest the formulation used by Applicants in their microetching process. There is no motivation in TAKATSU to modify his patent with the teachings of KUKANSKIS and/or VUGTS; but even if there were such motivation, the addition of KUKANSKIS and/or VUGTS to the teachings of TAKATSU in no way anticipates, suggests or renders obvious Applicants' invention any more than does TAKATSU alone. Neither KUKANSKIS nor VUGTS

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adds the inorganic phosphate salt absent in TAKATSU. The addition of the organic phosphate salt in TAKATSU results in copper surface smoothing, and reduced adhesion of subsequent materials over the copper, in contrast to the micro-pitting and surface roughening of the copper resulting from the Applicants' current invention. Absent this teaching, the limitations of claims 14 - 20 are believed to be only further limitations to allowable claims. Consequently, Applicants respectfully traverse their rejection under 35 U.S.C. §103(a) as being unpatentable over TAKATSU, in view of KUKANSKIS and VUGTS.

Claims 3, 4, and 7 were rejected under 35 U.S.C. §103(a) as being unpatentable over TAKATSU, in view of United States Patent No. 4,238,279 for COMPOSITIONS AND METHODS FOR TREATING SURFACE OF LITHOGRAPHIC PRINTING PLATE, issued December 9, 1980 to Yasuo Tsubai et al., United States Patent No. 5,550,006 for PHOSPHATING COMPOSITIONS AND PROCESSES, PARTICULARLY FOR USE IN FABRICATION OF PRINTED CIRCUITS UTILIZING ORGANIC RESISTS, issued August 27, 1996 to Gary B. Larson et al., and United States Patent No. 5,885,476 for COMPOSITION FOR MICROETCHING COPPER OR COPPER ALLOY, issued March 23, 1999 to Yoong-koo Hong et al.

TSUBAI teaches a process requiring the use of a "lithographic printing plate treating composition which consists essentially of (a) phosphoric acids, (b) nitric acid or salts thereof and (c) nitrous acid or salts thereof" (column 2, lines 60-63). Further, TSUBAI states that "at least one component of each of the components (a)-(c)" are required, and "if even one of components (a)-(c) is omitted, the objects of the present invention cannot be accomplished" (column 3, line 25-28). This teaches away from Applicants' claimed process and microetching solution in that Applicants clearly indicate that nitric acid is NOT suitable for use in their claimed process, and nitric acid or salts thereof are not included in Applicants' formulation (page 3, lines 14-16, and claim 5).

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HONG teaches a microetching composition comprising nitric acid or sulfuric acid or both; with ferric nitrate or ferric sulfate or both; and unsaturated carboxylic acids, or salts of carboxylic acid, or anhydrides of carboxylic acid in water (Abstract, and claims 1 and 4). The use of phosphoric acid or phosphate is not suggested within HONG. As a result, the teachings of HONG do not anticipate the current invention.

LARSON primarily teaches composition and methods for providing a phosphate conversion coating on a copper surface (column 2, lines 44-46). This primary teaching includes the use of a formulation including "at least one composition-soluble compound of an element selected from the group consisting of vanadium, niobium, tungsten and tantalum" (column 3, lines 1-3, and claim 1). The use of the phosphate conversion coating admittedly results in smooth copper surfaces (column 9, lines 38-42). This is in contrast to the unique formulation of the current invention which results in micropitting and surface roughening (page 10, lines 4-10). A secondary teaching is the use of "copper microetchant a phosphoric acid peroxide solution" before phosphate conversion coating (column 10, lines 59-61). Significant differences between Applicants' formulation and LARSON are the primary teaching of LARSON to use a vanadium, niobium, tungsten, or tantalum compound, and the secondary teaching limited to phosphoric acid peroxide solution.

Since it is believed that TAKATSU does not anticipate the invention, and that there is no motivation in TAKATSU to modify his patent with the teachings of TSUBAI, and/or HONG, and/or LARSON; but even if there were such motivation, the addition of TSUBAI, and/or HONG, and/or LARSON to the teachings of TAKATSU in no way anticipates, suggests or renders obvious Applicants' invention any more than does TAKATSU alone. The further teachings of TSUBAI, and/or HONG, and and/or LARSON do not anticipate the invention. Applicants respectfully traverse the rejection of claims 3, 4, and 7 under 35 U.S.C. §103(a) as being unpatentable over TAKATSU in view of TSUBAI, and/or HONG, and/or LARSON.

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Claims 10 - 12 were rejected under 35 U.S.C. §103(a) as being unpatentable over TAKATSU et al. in view of United States Patent No. 5,855,805 for MICROETCHING AND CLEANING OF PRINTED WIRING BOARDS, issued January 5, 1999 to Nancy D. Arabinick. ARABINICK teaches a surfactant for use in a microetching and cleaning operation of a copper-plated printed circuit board, and a phosphate anion as a solubilizing compound in the group of anionic surfactants (column 6, line 22). However, ARABINICK does not teach the use of inorganic phosphate salts to buffer and control the etching action of phosphoric acid, as shown by Applicants' formulation. The differences are significant, most importantly including the use of an inorganic phosphate salt by Applicants in order to stabilize the microetching solution. "The phosphate salts play several important roles in the process including, acting to buffer and stabilize the inventive microetchant formulation" (page 14, lines 10-13). Consequently, adding the teaching of ARABINICK to that of TAKATSU fails to either teach or suggest Applicants' microetchant formulation. Therefore, Applicants believe that claims 10 - 12 merely recite additional limitations to the allowable claim from which they depend and respectfully traverse their rejection under 35 U.S.C. §103(a) as being unpatentable over TAKATSU in view of ARABINICK.

Claims 1-7 and 14-17 were rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1-20 of United States Patent No. 6,156,121. United States Patent No. 6,156,121 and the present application are both assigned to International Business Machines Corporation. A terminal disclaimer in compliance with 37 CFR §1.321(c) is attached, in order to obviate the double patenting rejection over the prior patent, therefore traversing the rejection of claims 1-7 and 14-17.

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Applicants believe that claims 1 - 20 are now in condition for allowance. In view of the foregoing remarks, Applicants respectfully request that claims 1 - 20 be allowed and a timely Notice of Allowance be issued in this case.

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